

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

[COOPERATING WITH THE OHIO AGRICULTURAL EXPERIMENT STATION
CHARLES E. THORN, DIRECTOR.]

SOIL SURVEY OF THE WOOSTER AREA, OHIO.

BY

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[Advance Sheets—Field Operations of the Bureau of Soils, 1904.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1905.

[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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MAP.

Soil map, Wooster sheet, Ohio.

SOIL SURVEY OF THE WOOSTER AREA, OHIO.

By THOMAS A. CAINE and W. S. LYMAN.

LOCATION AND BOUNDARIES OF THE AREA.

The Wooster area is located in northeastern Ohio and includes a large proportion of Wayne and Stark counties and smaller areas

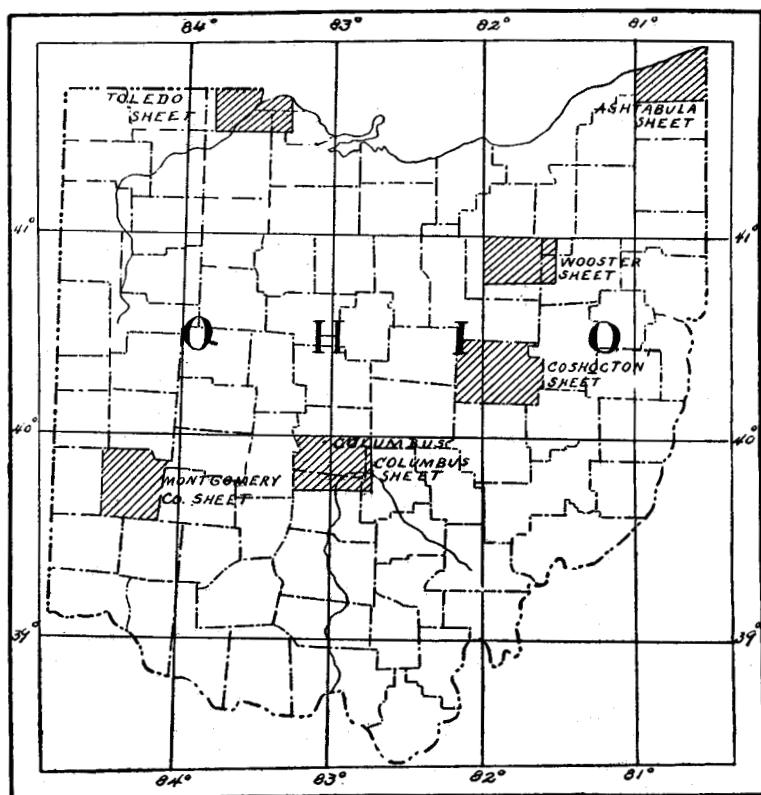


FIG. 1.—Sketch map showing location of the Wooster area, Ohio.

in Medina and Summit counties. It is rectangular in shape, having a width of about 17 miles north and south and a length of about 27

miles east and west. It is included within parallels 40° 45' and 41° north latitude, and meridians 81° 30' and 82° longitude west from Greenwich, and therefore has an area of 300,352 acres, or about 469 square miles. The cities of Wooster and Massillon are situated within the area.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

Although the first permanent settlement within the present limits of Ohio was made in 1788, it was not until 1805 that any settlements took place within the limits of the area surveyed. Between 1807 and 1810 several settlements were made in the vicinity of Wooster. In 1808 the town of Wooster was laid out, and two years later the first State road in the area, extending from Canton to Wooster, was built.

The first settlers made their way into the region from their eastern homes in wagons, and some even came on foot. They usually took up lands along the larger streams, or "second bottoms," where water for domestic purposes was abundant and where power for the operation of mills was obtainable. There was no incentive in those days to cultivate the soil except to supply the family needs, to support the stock, and to pay the taxes. The forests and streams furnished an abundance of game and fish. There were no local markets and little exchange of products with the older settlements, because of distance and cost of transportation. The nearest markets were Pittsburgh and Cleveland. The prices of the staple products, such as wheat, corn, and potatoes, were extremely low. Wheat sold in Wooster as low as 25 cents a bushel.

The first impetus to agriculture occurred during the era of canal construction. With the completion of the Erie Canal from Albany to Buffalo in 1825 and the construction of the Ohio Canal in 1828, which connected the area with Cleveland, immigration increased and agriculture began to develop along all lines. In the decade that followed there was a great influx of Germans from Pennsylvania, and later of German immigrants, so that at present about 70 per cent of the population of the area is of this race. With the improvement in transportation and the increase of settlers the uplands were gradually cleared and prepared for cultivation, as well as the lands along the streams. Grain was the chief product, and large quantities of it were hauled from all parts of the area to Fulton and Clinton and shipped to Cleveland, Buffalo, and New York.

The agricultural development of the area has kept pace with the opening up of means of communication with other parts of the country. The first railroad to penetrate the area was the Pittsburgh, Fort Wayne and Chicago, which in 1852 connected Wooster and Massillon

with the East. During the era of railroad construction that followed all lines of industry were stimulated even more than in the period following canal construction. Better methods of farming were introduced and larger areas were put under cultivation. The mining industry in the eastern part of the area was soon brought into prominence and manufacturing was established. There have been, however, several periods of depression, notably after the construction of transcontinental railroads, when the area came into competition with the new West, where there were vast tracts of prairie lands, upon which grazing and grain growing could be carried on more cheaply than upon the small eastern farms. The products of these new lands were put upon the eastern markets more cheaply even than they could be produced in this area. By a judicious system of diversified farming the industrious German farmers of the area have adjusted themselves to these new conditions. As an adjunct to general farming many of them are engaged in feeding horses. Two and three year old draft and coach horses are sent from Indiana and Illinois by the carload and let out by local dealers to the farmers to be fed until they are 5 years old. Many carloads of these horses are shipped to the eastern markets annually.

CLIMATE.

At Wooster the hottest months are July and August, when the temperature seldom gets above 100° F. for more than one day, and the normal for these two months, computed from records covering fifteen years, is about 70° F. The coldest month is February, during which the mercury seldom falls below zero, and the normal is 26.8° F. The normal annual temperature at Wooster is 49.2° F., while that for the whole State for the same period is 51.1° F.

At Wooster the greatest precipitation takes place during May, June, and July, when the growing crops are most in need of rain. The normal for these months is a little over 4 inches per month. April is the month in which the least precipitation occurs, the normal being 2.39 inches. The normal annual rainfall at Wooster is about 38.5 inches, while that for the whole State for the same period is about 37 inches.

There is usually plenty of rainfall for the heavier soils, but sometimes such types as the Miami gravelly loam, Miami sandy loam, and Miami sand suffer from drought during the month of August. In the winter there is usually enough snow to protect the wheat. All crops are about two weeks later in the area than in the southern part of the State.

The following table shows the normal monthly and annual tem-

perature and precipitation for the Weather Bureau stations at Wooster, Killbuck, and Medina:

Normal monthly and annual temperature and precipitation.

Month.	Wooster.		Killbuck.		Medina.	
	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.
	° F.	In.	° F.	In.	° F.	In.
January	25.9	2.74	27.8	2.48	25.6	2.74
February	27.8	3.42	26.4	2.55	25.8	2.10
March	35.2	3.28	38.7	3.29	36.5	3.56
April	47.9	2.38	50.8	3.77	49.2	2.58
May	57.8	4.26	60.8	3.63	60.1	3.53
June	68.3	4.04	70.3	2.92	68.3	2.49
July	71.1	3.93	73.4	4.68	72.6	4.23
August	67.0	2.44	71.8	2.70	70.6	3.45
September	62.9	3.05	64.6	2.94	65.5	2.58
October	50.3	2.35	50.7	1.78	51.9	2.02
November	39.6	3.23	39.6	3.23	41.4	3.48
December	32.2	2.77	31.2	-----	30.6	3.04
Year	48.8	37.89	50.5	-----	49.8	35.80

PHYSIOGRAPHY AND GEOLOGY.

The area is located along the southern crest of the divide between the Lake Erie and Ohio River drainage, with nearly all of the streams flowing in the latter direction. The region is made up mostly of gently rolling uplands and wide shallow valleys, but in the coal region in the vicinity of Massillon, Dalton, and Doylestown it is rather hilly and broken and farmed with less ease than in the western part of the area.

The uplands are cut by two deep preglacial drainage channels, one at Wooster and the other at Massillon. As shown by well borings, these channels were originally much deeper than at present, but were partially filled with drift material during the Glacial period. The difference in elevation between the streams that flow in these valleys and the tops of the hills varies from 100 to 200 feet. There are no gorges or rock exposures, however, as the sides of the valleys are covered with glacial till and in most cases permit of cultivation to the top. The lowest point in the area is 925 feet above sea level, while the highest point is 1,275 feet, so that throughout the area there is a difference in elevation of only 350 feet.

The soils upon the valley floor are alluvial in origin, having been deposited either by torrents at the close of the Glacial period or by the spring freshets since that period.

In the lowest parts of the valleys and along the flat divides, where the drainage conditions were naturally poor, sedge grasses, mosses, and similar vegetation flourished, and the accumulations year after

year account for the deep deposits of Peat at Creston, Orrville, and Lodi.

The soil-forming glacial till found at present upon the uplands represents approximately the character of the material left at the close of the Glacial period. A great deal of the material is local, being derived from the underlying rock formations.

The investigations of the State geologists of Ohio, as recorded in the reports and maps, show that the underlying rocks of the area belong to the Carboniferous period. The rocks of this period are subdivided into various formations, the Black Hand, Logan, Maxville, and Pottsville formations being the ones represented in the area.

Each of these underlying formations has its own characteristic rock, which, when it comes close to the surface, often imparts that characteristic to the soil; but when deeply covered with glacial till its influence is not so noticeable.

In the southwestern part of the area, in the vicinity of Wooster, the rocks of the Black Hand and Logan formations come rather close to the surface and enter largely into the formations of the overlying soil. Farther to the northward, however, in the vicinity of Golden Corners, these formations thin out and are displaced by an argillaceous shale, which has imparted to the soil a more clayey nature than at Wooster.

After passing eastward above the Black Hand and Logan formations the Maxville limestone appears rather close to the surface in places, especially upon the hills above North Lawrence. The soil is quite heavy in that locality. The limestone is burned by some of the farmers, and lime is said to be very beneficial to the soil.

Passing eastward above the Maxville limestone there is found for some distance the Pottsville formation, the rocks of which are largely sandstone. Although this formation is usually deeply covered with glacial till, the underlying sandstone has been somewhat mixed with this till and has had its influence upon the soil. The sandstone of this formation is quarried at Massillon and is widely known and extensively used for structural purposes, for grindstones, and in the manufacture of glass. Besides its quarries, the Pottsville formation is also important for its coal beds. In the eastern part of the area the coal interests are extensive, and there are at present many active mines. In the same formation, and sometimes associated with the coal, are beds of clay which are worked for pottery and brick purposes.

SOILS.

There are nine distinct types of soil in the Wooster area, five of which belong to the Miami series.

The following table gives the extent of the several types and the proportion of the whole which each forms:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami clay loam	119,104	40.0	Miami gravelly loam	4,928	1.6
Volusia silt loam	79,424	26.5	Miami sand	2,496	.8
Miami stony loam	51,200	16.9	Yazoo clay	1,216	.4
Waverly clay	24,256	8.1	Total	299,712	
Miami sandy loam	11,328	3.8			
Peat	5,760	1.9			

MIAMI CLAY LOAM.

The soil of the Miami clay loam consists of a brown loam or clay loam which contains a high percentage of silt. It varies from 9 to 12 inches in depth, with an average of about 10 inches. The line of demarcation between soil and subsoil is quite distinct as to color and texture. The subsoil to a depth of 20 inches is a light-brown or yellowish clay loam, below which the clay content increases considerably, the texture changing to a clay and the color to a mottled drab and yellow. It is comparatively free from the gravel and rock fragments which are characteristic of the Volusia silt loam and which aid materially in the underdrainage of the latter type. Glacial bowlders, however, are usually present in considerable numbers, and in places they were formerly so plentiful as to interfere with cultivation.

The type is found in the northern and eastern parts of Wayne County and in western Stark County. Large bodies of it are also found in Medina County, outside of the area. Within the area it is typically developed in the region between Golden Corners, Burbank, and Jackson, in Wayne County, and in the region between Dalton, East Greenville, and North Lawrence, in the southeastern part of the area.

The desirability of Miami clay loam for general farming depends considerably upon whether it is located in a comparatively level region, where the drainage conditions are naturally poor, or whether it is more rolling and consequently better drained. The first condition is found in the vicinity of Golden Corners, 9 miles north of Wooster, where it occupies a comparatively level region, characterized by beech woods, locally known as "Büchenwald." Here a smaller proportion of the type is under cultivation, and the farmers are less prosperous than where it is found in more rolling or hilly areas bordering streams, as, for example, in the vicinity of North Lawrence and East Greenville. Tile drainage has greatly improved the type by making it more porous and less subject to drought in dry seasons. It has also made it a warmer soil, which may be plowed

earlier in the spring than formerly. It is rather a difficult soil to till, owing to its clay content, but when brought to a high state of productivity it is easily maintained because the fertilizing ingredients are more lasting than is the case with types having a porous subsoil.

The Miami clay loam is glacial in origin, being a mixture of the heterogeneous ground-up rock fragments transported from the north in the Glacial time, and more or less intimately mixed with the ground-up fragments of local rocks.

The Miami clay loam is important in point of areal extent, and when naturally or artificially well drained it may be used for any of the general farm crops of the region. In the early days it was covered with forests, consisting of beech, maple, hickory, and oak. It was not cleared and put under cultivation until about fifty years ago. It is not naturally a very productive soil, but it responds readily to careful handling and retains fertilizers very well. It is well adapted to hay, and also, if thoroughly drained, to wheat. All spring-sown crops, including potatoes, give satisfactory results. Apples, grapes, strawberries, and raspberries do remarkably well when properly cared for, but peaches do not thrive. A smaller proportion of this soil is under cultivation than is the case with the Volusia silt loam, and the general appearance of farm buildings, fences, and orchards does not indicate the same degree of prosperity as is attained upon the latter type.

Grass, wheat, corn, oats, potatoes, and fruits are the principal products grown. Wheat will average about 15 bushels per acre, corn about 40 bushels, when well cultivated, and oats about 50 bushels in ordinary seasons. This type generally shows an acid reaction when tested with litmus paper, and the application of lime would doubtless prove beneficial.

The following table gives the results of mechanical analyses of the fine earth of typical samples of this soil:

Mechanical analyses of Miami clay loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
10752	3 miles N. of Madisonburg.	Brown silty loam, 0 to 10 inches.	0.6	1.9	1.3	3.5	10.0	63.4	19.4
10926	2½ miles E. of Marshallville.	Brown clay loam, 0 to 9 inches.	1.1	1.6	1.3	3.8	6.1	57.7	27.5
10753	Subsoil of 10752	Yellow clay loam, 10 to 36 inches.	1.6	1.9	1.0	3.6	12.3	50.1	23.9
10927	Subsoil of 10926	Yellow clay, 9 to 32 inches	.4	1.1	1.0	3.2	5.2	43.5	45.0

MIAMI STONY LOAM.

The soil of the Miami stony loam is a brown silty loam, with an average depth of about 12 inches, and grading gradually into a subsoil of yellowish and sometimes reddish loam or clay loam. At a depth of from 4 to 10 feet it is often underlain by gravel, sand, and boulders, which, as seen in road cuts and in gravel and sand banks, exhibits little evidence of stratification.

In texture this type is intermediate between the Miami clay loam and the Miami sandy loam, but there are important characteristics which separate it from either of these types. The subsoil appears considerably more clayey than that of the former and more sandy than that of the latter, and scattered upon the surface and disseminated through both soil and subsoil are numerous well-rounded glacial boulders, varying usually from 1 to 10 inches in diameter, with occasionally some much larger. Formerly these rocks were so numerous as seriously to interfere with cultivation, and in places the farmers still have trouble, the stones being so numerous that they are plowed up year after year.

The Miami stony loam is confined to the northeastern part of the area and is found typically developed on the uplands in the vicinity of a group of lakes south of Akron. It is characterized by an uneven topography, consisting of many hills and ridges with kettle-hole depressions between. Occasionally there are broad, gently rolling uplands, and when such is the case the subsoil contains a little more clay, and the type is more desirable for general farming than on the sidehills, where the surface often washes badly and is subject to drought in dry seasons. As a whole, the type is naturally well drained, except in the kettle holes, which are usually only a few acres in extent, too small to be shown on a map of the scale used. Some of these are filled with water throughout the year, while others dry up during the summer. In some cases these areas have been successfully drained, but in many others the expense of digging an outlet would make drainage unprofitable. The character of the material found in the depressions is the same as that found in the larger poorly drained areas, viz, peat, marl, or sand or clay deposits washed from the adjoining hills.

The Miami stony loam is derived from the weathering of glacial till, which is usually of great thickness. Occasionally, however, along the borders of the preglacial valleys or where the till has been removed by erosion the underlying rocks appear and enter somewhat into the formation of the soil. Notwithstanding its rough, hilly topography the Miami stony loam is a fairly satisfactory type for

general farming. When not too hilly it is more easily handled than the Miami clay loam, because its clay content is not so high. It is a warmer soil than the Miami clay loam and better adapted to peaches, corn, and potatoes. It is not naturally a very productive soil, but areas where the surface is not too steep are capable of being brought to a high state of cultivation, and the productivity is easily maintained. Timothy and clover do well, and dairying would doubtless be a profitable industry. Its varied topography also makes it a desirable type for fruit and berries. Wheat yields from 15 to 30 bushels per acre, depending upon the season, location, and care taken; corn averages about 40 bushels, oats from 30 to 60 bushels, and potatoes from 75 to 150 bushels per acre.

The following table gives the results of mechanical analyses of the fine earth of samples of this soil:

Mechanical analyses of Miami stony loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
10948	2 miles NE. of Clinton.	Brown silty loam, 0 to 10 inches.	1.3	2.2	3.2	7.4	10.3	58.4	17.1
10950	1½ miles SW. of Warwick.	Brown silty loam, 0 to 8 inches.	.7	1.8	2.3	4.7	5.6	65.2	19.5
10951	Subsoil of 10950	Yellow silty loam, 8 to 30 inches.	.8	2.1	2.5	5.4	5.1	60.0	23.8
10949	Subsoil of 10948	Clay loam, 10 to 36 inches	.8	2.7	3.4	9.1	8.2	42.3	33.7

MIAMI GRAVELLY LOAM.

The Miami gravelly loam consists of a heavy brown loam, varying in depth from 8 to 15 inches, with an average of about 10 inches. The subsoil is a heavier yellowish and sometimes reddish loam or clay loam to a depth of about 24 inches, below which the gravel content increases somewhat until, at 30 inches, the material becomes a mixture of gravel and coarse sand. As shown by gravel pits and well records, the substratum of the type consists of alternate beds of gravel and sand, sometimes to a great depth. At Sterling, in the Tuscarawas Valley, this deposit of sand and gravel is 400 feet deep.

The soil usually contains considerable coarse, sharp, angular sand and fine gravel, and there are local variations in the type where the soil is very much sandier. Such spots, caused by the near approach of the underlying sand and gravel to the surface, are found

upon the crests of knolls, and are usually not more than an acre in extent.

The Miami gravelly loam is locally known as "second bottomis," and is found at elevations varying from 20 to 40 feet above the streams. It is never subject to overflow. The surface varies from almost level to gently rolling. Its topography, in addition to the fact that it is underlain with gravel, gives the soil excellent drainage. In the typical areas of the soil, where the subsoil consists of a heavy loam or clay loam, it retains moisture well, but where least typical, as, for example, on the asylum farm at Massillon, where the subsoil is lighter in texture, it is inclined to be droughty.

The beds of sand and gravel forming the deep subsoil of this type are glacial in origin. The soil itself may be residual, i. e., derived from the weathering of the underlying sand and gravel beds, or it may be largely alluvial, formed by the annual overflow of the streams when their channels stood at higher levels, in much the same manner as the Waverly clay is being formed at present. The type is found closely associated with the Waverly clay, and in some cases the textural characteristics are quite similar, making it rather difficult to fix the boundaries between the two. The Miami gravelly loam, however, is a much more desirable type for general farming in this area than the Waverly clay, owing to the poor drainage of the latter.

The Miami gravelly loam was among the first types to be taken up by the early settlers who, with few exceptions, made their homes along the larger streams. The chief causes influencing their choice were the advantages of near water supply and the ease with which the lowlands could be put under cultivation. The trees which grew in these locations were the alder, mulberry, willow, haw, and wild plum, all of which were comparatively easy to remove. The typical Miami gravelly loam is a fairly safe soil for all general farm crops, in addition to which considerable quantities of tobacco of the Little Dutch cigar filler type have been grown upon it with satisfactory results in the vicinity of Creston and Sterling. If conveniently situated near a market the best areas could also be profitably used for truck crops.

Wheat will yield on this soil from 10 to 35 bushels per acre, depending upon the season and the condition of cultivation. Corn will average about 40 bushels per acre and oats about the same, although much larger yields of both are not uncommon. The tobacco grown, "Little Dutch," gives an average yield of 1,200 pounds, and potatoes sometimes yield as high as 150 bushels per acre.

The following table gives the results of mechanical analyses of the fine earth of this type of soil:

Mechanical analyses of Miami gravelly loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
10754	2 miles SE. of Sterling.	Brown loam, 0 to 10 inches....	4.3	9.3	6.2	6.3	7.9	50.5	15.5
10944	2 miles SE. of Sterling.	Brown loam, 0 to 8 inches....	2.3	5.5	4.2	8.0	8.1	52.8	19.2
10755	Subsoil of 10754...	Yellow sandy loam, 10 to 40 inches.	8.1	23.5	15.7	9.1	7.7	22.7	13.3
10945	Subsoil of 10944...	Brown clay loam, 8 to 30 inches.	2.0	6.4	4.1	9.8	10.5	39.7	27.2

MIAMI SANDY LOAM.

The Miami sandy loam consists of from 10 to 14 inches of brown to dark-brown sandy loam, underlain by a lighter colored compact sandy loam containing a little more clay than the soil. There are two phases of the type, one found in the valleys and the other in the uplands. In the lowland phase the subsoil is occasionally gravelly at a depth of 36 inches, while in the uplands the subsoil sometimes becomes slightly more clayey in the lower depths. Upon the hills the soil is a little lighter colored than in the valleys.

In the lowlands the Miami sandy loam is found along all the larger streams in the area, either adjacent to the streams or back from the streams upon terraces. In the upland it is well developed in the northeastern part of the area in the hilly region south of Akron. The lowland areas are flat or gently rolling. In the upland the type occupies smoothly rounded hills and terraces adjoining preglacial valleys. The hills are sometimes small and have kettle-hole depressions between them. The soil upon the hills is lighter colored and more sandy than farther down the slope or in the depressions.

Occasionally the lowland areas are flooded in the spring, but, owing to the porous nature of the subsoil, they dry off quickly and there is little delay in plowing or planting. Owing to its hilly topography the upland phase is also a well-drained early soil, the only exceptions being the small kettle-hole depressions, which often contain water until late in the summer. The type as a whole is subject to drought in the latter part of the growing season, and unless the rainfall is considerable crops do not usually do well.

The lowlands of this soil are purely sedimentary in origin, the material having been deposited when the streams were swollen and the currents too swift to permit of the deposition of silt and clay. The upland areas are largely derived from the glacial mantle, which in the northeastern part of the area is composed mainly of sandy material. Some of the hillocks and elongated ridges have the appearance of eskers and kames.

Potatoes, corn, tobacco, wheat, oats, hay, and truck are successfully grown, the type as a whole, however, being best adapted to potatoes, corn, tobacco, and truck. The lowland phase is particularly well adapted to corn, potatoes, and tobacco, the latter crop being grown more extensively on this than on any other soil in the area. In general potatoes yield from 75 to 150 bushels; corn about 50 bushels, and tobacco—the Zimmer Spanish variety—from 800 to 1,400 pounds per acre, the latter figure representing the best yields on the lowland phase of the type. The success of crops depends largely upon the season, and the yields above given are those obtained in favorable seasons. In the uplands during the prolonged droughts that sometimes occur in the growing season grass and small grains suffer serious damage. As a rule the type is too dry for oats, and it is difficult to get a stand of clover because the seedlings burn off after the wheat is cut. In the region north of Sterling tobacco is very successfully grown.

The following table gives the results of mechanical analyses of typical samples of this soil:

Mechanical analyses of Miami sandy loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
10756	Sterling.....	Brown sandy loam, 0 to 12 inches.	3.5	9.4	11.6	29.2	11.7	24.1	10.3
10934	$\frac{1}{2}$ mile S. of Seville.	Dark brown sandy loam, 0 to 8 inches.	.4	2.5	6.7	34.0	20.4	22.4	13.6
10757	Subsoil of 10756..	Brown sandy loam, 12 to 40 inches.	4.0	11.0	12.1	27.2	8.5	22.5	14.6
10935	Subsoil of 10934..	Yellow sandy loam, 8 to 30 inches.	.7	3.1	6.2	7.6	36.6	25.0	20.6

MIAMI SAND.

The Miami sand is a light-brown to brown loamy sand, usually from 8 to 16 inches deep, resting upon a subsoil of loose, incoherent yellowish sand of unknown depth. The type is characterized by its loose, sandy texture, and the relatively large proportion of the coarser grades of sand in both soil and subsoil. The soil is slightly heavier in texture than the subsoil owing probably to the more perfect weathering of the sand particles since their deposition, and probably also to the fact that there is more humus incorporated with the soil than with the subsoil.

The Miami sand is found principally in the northeastern part of the area, in the northern part of Stark County, and in the southwestern part of Summit County. It is especially well developed near Clinton and in isolated patches southeast toward Massillon. It is also found bordering the group of lakes south of Akron.

In the vicinity of Clinton the type is level and gently rolling, but in the lake region south of Akron the surface is made up of knolls and ridges, with kettle holes and expanses of lowlands intervening. The soil upon the elevations is lighter colored and lighter in texture than that in the intervening lowlands.

Owing to the loose, porous nature of the soil and subsoil and its usual undulating topography the type is naturally well drained except in the kettle-hole depressions and swampy areas bordering the group of lakes already mentioned.

The Miami sand is both glacial and alluvial in origin. In the valley near Clinton it is purely alluvial, being composed of the sandy materials washed from the adjoining uplands and deposited upon the floor of the valley during spring floods when the stream ran at a higher level than at present. In the lake region some of the type has the appearance of having been laid down as eskers and kames at the close of the Glacial period, while in other places, especially bordering the lakes, it seems to have been formed by wave action when the lakes stood at a higher level.

Wheat, corn, oats, grass, potatoes, truck, and fruit are grown upon this type of soil. Where the type borders the foothills and receives the seepage water from higher ground the crops do much better than in areas lacking this advantage of moisture condition. The average yield for wheat is about 10 bushels per acre. Oats do well only in wet years. Corn will average about 25 bushels per acre. It is only occasionally that a crop of grass is seen. In a good year potatoes do very well, but with the average season the yield is about 75 bushels per acre. If conveniently located as to markets this soil would make an excellent type for truck and fruit farming.

The following table gives the results of mechanical analyses of typical samples of this soil:

Mechanical analyses of Miami sand.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
10942	½ mile W. of Rex Lake, Summit County.	Brown sand, 0 to 12 inches...	P. ct. 8.7	P. ct. 32.8	P. ct. 17.3	P. ct. 21.1	P. ct. 4.7	P. ct. 7.5	P. ct. 7.3
10940	1 mile S. of Clinton.	Brown sandy loam, 0 to 10 inches.	4.3	17.7	25.5	19.3	4.4	17.3	11.4
10941	Subsoil of 10940..	Yellow sand, 10 to 40 inches..	8.1	25.3	26.4	22.1	6.0	5.8	6.0
10943	Subsoil of 10942..	Coarse to medium sandy loam, 12 to 36 inches.	3.7	23.6	17.3	18.9	5.7	19.4	11.2

YAZOO CLAY.

The Yazoo clay consists of about 10 inches of black clay, underlain by from 2 to 8 inches of stiff, impervious, bluish-black clay, below which, to unknown depths, is a stiff impervious blue clay. In the Wooster area this type is found only in a few isolated patches and always as depressions in the valleys and is subject to overflow. The largest body occurs 5 miles south of Wooster in the Killbuck bottom. Its surface is almost flat or slightly basinlike.

When the region was first settled the depressions occupied by this soil were covered with water during most of the year, and a rank aquatic vegetation flourished during the summer. It has only been during the past score or so of years that they have been brought under cultivation, and prior to that time they were either too swampy for any use or served only for pastures during the dry season. Before any crop could be grown deep, wide open ditches with shallower laterals had to be dug, and later tile drains were laid with outlets into the open ditches. Upon thorough drainage this type becomes less sticky and impervious to water, more friable, and more easily worked. Yazoo clay owes its origin to the intermingling of decayed remains of rank swamp and aquatic plants, the wash of fine mineral particles from the hills, and the sediments left by freshets.

The type makes the best corn land in the area, and sometimes yields as high as 100 bushels per acre. It is not suited to wheat because of the spring freshets. It is not adapted to spring grain crops because they grow too rank. Potatoes yield well, but the quality is not good. This soil is best adapted to corn, grass, and pasture.

The following table gives the results of mechanical analyses of typical samples of this soil:

Mechanical analyses of Yazoo clay.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
10992	3 miles S. of Wooster.	Dark clay, 0 to 10 inches	Tr.	1.4	0.6	1.8	7.6	40.2	48.9
10990	3½ miles NW. of Smithville.	Dark-brown clay, 0 to 10 inches.	.0	.8	.6	1.6	7.1	39.4	49.9
10993	Subsoil of 10992 ..	Waxy clay, 10 to 36 inches ...	Tr.	.6	.3	1.4	5.8	34.0	57.2
10991	Subsoil of 10990 ...	Stiff clay, 10 to 36 inches	Tr.	Tr.	.9	2.3	6.9	26.5	63.3

WAVERLY CLAY.

The soil of the Waverly clay, to a depth of from 9 to 12 inches, is a clay or clay loam, varying in color from brown to dark gray. Usually there is considerable sand in the soil, and when put under cultivation it becomes quite loamy. The subsoil is lighter in color and usually considerably heavier in texture than the soil, and in its lower depths consists of material known locally as "blue clay." Sometimes there are slight elevations in areas of this type that are a little sandier than the typical soil, but such areas are rarely more than an acre or two in extent. Occasionally there are depressions where the soil is darker colored and more clayey than in the true soil, but these are likewise of limited extent and the type, as a whole, is quite uniform in texture.

The Waverly clay is found in the first bottoms along all the larger streams, and, as would be expected, its topography as a whole is rather flat. The areas lie at elevations ranging from 5 to 20 feet above the present stream beds, and vary in width from one-eighth to 1½ miles. The soil is subject to annual inundation, and, owing to obstructions of logs and driftwood, the spring flood waters were formerly held in check during most of the summer. Such is the case at present where the timber has not been cleared off. It is a difficult soil to drain, owing to its slight elevation above the streams and the impervious nature of the subsoil. Much improvement in the drainage conditions has been brought about by digging deep, wide ditches, using steam dredges for the purpose. Into these main ditches the shallower laterals and tile drains are led, and wide areas of the land formerly held in low esteem have been reclaimed and put under cultivation.

Geologically, this soil type is the youngest in the area. Each successive spring freshet carries some of the clay, silt, and sands from the uplands and redeposits them as a thin layer of sediment upon the floor of the valley, so that the type is still in process of formation.

Only a small proportion of the type is under cultivation and a considerable part of it is still covered with the original forest of oak, elm, sycamore, and hickory. The tracts under cultivation have proved to be among the most productive in the area, while others are used largely for meadow and as a pasture for stock during the summer and fall months. A few areas have been in continuous cultivation for over fifty years without the application of fertilizers or manure and are still very productive, the spring freshets tending to rejuvenate the soil year after year. The type is used principally for corn, to which it is especially adapted, the yield in good seasons being 75 bushels per acre. A little wheat is grown, but the soil is too wet for this crop.

The following table gives the results of mechanical analyses of typical samples of this soil:

Mechanical analyses of Waverly clay.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.05 to 0.001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
10922	Rittman	Brown clay, 0 to 12 inches ...	Tr.	0.6	1.0	4.6	10.1	47.4	36.2
10924	1 mile W. of Wooster.	Brown clay, 0 to 10 inches ...	0.3	.9	1.0	2.9	6.7	35.4	52.9
10925	Subsoil of 10924 ..	Mottled clay, 10 to 36 inches ..	.2	.6	.5	2.2	10.1	42.0	44.0
10923	Subsoil of 10922 ..	Mottled clay, 12 to 36 inches ..	.0	.6	.5	2.5	8.6	41.7	45.8

VOLUSIA SILT LOAM.

The soil of the Volusia silt loam is a brown silt loam with an average depth of 10 inches. The line of demarcation between the soil and the subsoil is quite distinct as to color, but not as to texture. To a depth of about 20 inches the subsoil is a light-brown or yellowish silt loam, only slightly heavier in texture than the soil. Below 20 inches the clay content increases somewhat, and in depressions where underdrainage is imperfect the clay content becomes considerably greater and the color becomes a mottled drab and yellow.

Throughout both soil and subsoil of the Volusia silt loam, and scattered upon the surface, are considerable quantities of shale, sandstone fragments, and gravel, all of which are derived from the under-

lying formations. There are local variations in the type, depending upon whether it is found on steep valley slopes or on the broad, gently rolling interstream areas, or whether it has been properly farmed or subjected to wasteful methods of cultivation and consequent injury from erosion. As a rule, however, it is a very uniform type, and the one upon which the farmers have been most prosperous.

It is found in one very large, continuous body and other important tracts in Wayne County in the southwestern and south-central parts of the area, and in a few disconnected smaller areas in Stark County, in the southeastern part of the area. It is typically developed in the region between Smithville and Wooster and for several miles west of Wooster outside of the area surveyed. Owing to the loose, loamy nature of this soil and the presence of fragments of sandstone, shale, and gravel, it is naturally a well-drained, easily tilled type. Except in the most level locations it can usually be plowed in the spring earlier than any other upland type in the area. It is not, however, a droughty soil, the deeper subsoil being quite retentive of moisture, which rises readily in times of drought. It is an easy type to erode, and in hilly areas the best farmers exercise great care to keep the fields from gullyng. For this reason no plowing is done in the fall, tile drains are laid, and the ravines of cultivated fields are allowed to remain sodded.

In general the Volusia silt loam is a residual soil, derived from the weathering of fine-grained sandstones and shales of the Waverly Group and the Lower Coal Measures. The underlying rocks are usually not far below the surface and can quite often be seen in the road cuts, on the crests of hills, and in quarries. The whole region has been glaciated, but the glacial debris from the north has entered but slightly into the composition of this type, nearly all of the material being of local origin.

Wheat, corn, oats, and fruit are the most important crops of the Volusia silt loam, although it is well adapted to all the varied products suited to the climate. The average yield for wheat is about 20 bushels per acre and yields as high as 30 bushels are not uncommon. Corn, under the best cultural methods, will average 40 or 45 bushels per acre. Oats will yield an average of 50 bushels per acre, although larger yields are often reported. From 100 to 150 bushels of marketable potatoes per acre is the average production of this crop, depending upon the methods of cultivation, location, and season. Little fruit is grown except for home consumption, but a noticeable feature of the type is that every farm has its apple, peach, plum, and cherry trees and grape vines. In some instances the apple and peach orchards are quite large. Considerable timothy and clover hay are grown, but difficulty is frequently experienced with the clover dying

out in spots, and again it is difficult to get a suitable stand of the clover seedlings. This, however, has not always been the case, for formerly it was a very good clover soil. By the litmus-paper test in the field the type shows an acid reaction. This acidity may be corrected by lime, as discussed elsewhere.

This type of soil was originally forested with white, red, and black oak and some chestnut.

The price of the Volusia silt loam ranges from \$10 to \$20 more per acre than that of the Miami clay loam.

The following table gives the results of mechanical analyses of the fine earth of typical samples of this soil:

Mechanical analyses of Volusia silt loam.

No.	Locality.	Description.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
10750	Wooster	Brown silty loam, 0 to 10 inches.	1.4	2.3	1.1	2.1	15.4	60.6	17.1
10850	2 miles N. of Applecreek.	Brown silty loam, 0 to 10 inches.	1.4	2.6	1.3	2.7	6.8	65.8	19.4
10854	2½ miles SW. of Smithville.	Brown silty loam, 0 to 10 inches.	1.3	1.6	1.0	2.8	7.5	65.4	20.1
10751	Subsoil of 10750 ..	Silty clay loam, 10 to 36 inches.	.8	1.1	.7	1.9	18.5	59.0	18.5
10851	Subsoil of 10850 ..	Light-brown loam, 10 to 36 inches.	3.8	4.4	2.2	4.3	9.7	55.0	20.6
10955	Subsoil of 10854 ..	Yellow silty loam, 10 to 30 inches.	.8	1.6	1.0	2.1	9.1	57.1	27.8

PEAT.

Peat is a mass of roots, sedge grass, moss, etc., in various stages of decay. It is black or brown in color, the latter color predominating in the lower depths. Underlying this mass, the depth of which varies from 2 to 15 feet, is a stiff, impervious blue clay.

This type is found in different parts of the valley of Killbuck Creek and in the region near the lakes in the northeastern part of the area. It occurs sometimes in depressions in the valleys, but more often on low divides between streams. Large areas sometimes mark the place of a former lake. Such was the origin of the areas near Orrville, Creston, and Lodi.

The flat physiography and the underlying impervious clay naturally make the type wet, and thorough draining is necessary before cultivation can be undertaken. Open drains are used almost without exception, and owing to the saturated condition of the soil and the

impervious nature of the subsoil the drains are placed with narrow intervals. When drained much of the humus and organic matter gradually disappears and the soil becomes lighter and settles. The settling is due in part to the removal of the water.

The first attempts to reclaim land of this type were discouraging. The best crops can be produced only after the land has been worked two or three years, as even with drainage established it takes some time for the soil to dry out. This lack of immediate returns delayed the reclamation and kept down the price of what is now the most valuable land in the area. Where the Miami sandy loam or the Miami sand lies adjacent to areas of Peat considerable sand is intermingled with the vegetable matter. Such areas grow very profitable crops of huckleberries.

Onions and celery are the crops to which this type is probably best adapted. Large quantities of both of these vegetables are grown, and the yields and quality compare very favorably with those obtained in other regions more famous for the production of such crops.

DRAINAGE.

When the region was first settled, and, in fact, until about sixty years ago, Newmans Swamp, near Orrville; Killbuck Swamp, near Wooster, and Creston Swamp were shallow lakes in the broad, flat, partially filled preglacial channels. Alder and willow grew in and around these lakes, and in places cranberries grew in abundance. As the country became settled and cleared, very marked changes took place in these marshy areas. With the removal of trees and other obstructions the streams receded to their channels, and were finally held there as a result of eroding their own channels deeper. Later, by the construction of deep, wide ditches and shallower laterals and by laying tiles large tracts of these lowlands were reclaimed, and to-day some which were once held in very low esteem are among the highest-priced lands in the area. The areas of Peat for example, which were formerly too wet for any use, are now the highest-priced lands in the area. The asking price is \$200 an acre, and the celery and onions grown upon them are said to be equal, in yield per acre and quality, to the Kalamazoo products.

Along the bottoms of all the larger streams of the area there are still larger bodies of land unfitted for anything except mowing lands and pasture. The Waverly clay, locally known as "first bottoms," is usually found in such locations. It is subject to annual inundation. Considerable work is being done at present to facilitate the reclamation of the lowlands in the vicinity of Sterling, where a steam dredge is at work excavating a deep, wide, straight channel for the stream, which heretofore has had a meandering course. The

result will be that the spring flood waters will run off much sooner and the stream will gradually deepen its own channel. Farther down the stream, in the vicinity of Rittman, there are thousands of acres which may be reclaimed in the same manner; and unless steps are taken to do so the downstream areas will be more subject to inundation than ever before, because the water will not stand as long upon the upstream flood plains as formerly.

All the other soil types in the area, except the Miami gravelly loam, Miami sandy loam, and Miami sand, are greatly benefited by tile drainage. The difficulty with the types just mentioned is that they are already too porous. Probably 50 per cent of the Miami clay loam and Volusia silt loam on the uplands are tiled. Notwithstanding the loose, loamy nature of the Volusia silt loam, it is greatly improved by tiling in all locations, even where it is quite rolling, for the tiles carry off underground the excess water of heavy rains, and thus tend to prevent erosion of the loose, loamy surface soil. The Miami clay loam is the type which receives the greatest benefit from tiling. In the undrained areas it is called a "cold, wet, late land." After draining it becomes warmer, and therefore can be seeded earlier in the spring. It also becomes more porous, and there is better and more uniform distribution of the soil water throughout the year. It is less subject to drought in the dry season, it works easier, there is a greater certainty of crops, and the yields are larger. Draining makes it a better wheat soil from the fact that the seedlings do not "heave out" so badly in the winter and spring. The areas of the Yazoo clay are also greatly benefited by tiling. The large tile works at Rittman furnish quantities of tile for the area and surrounding country. The materials for the manufacture of tile are near at hand, the source of fuel supply not far distant, and the cost of the finished product is moderate.

SPECIAL SOIL PROBLEM.

At the present time great difficulty is experienced in the Wooster area with the clover crop. Soils on which clover has been successfully grown for over half a century are now in such condition that this crop is wholly or partially a failure. In many instances it is difficult to get a stand, and after that is secured the seedlings often die out in spots throughout the fields. An examination of these spots, made during the survey by the litmus-paper test, reveals the fact that they are quite acid. An examination of the soil adjoining shows that it is acid also, but apparently not so much so as the affected spots.

The acidity of soils is thought by some to be due to the excessive use of acid phosphate. During the last decade a few farmers have been liming their fields, and the result is that clover does very much better.

The acid test was made of the soil of fields which had been limed. Nearly all portions of such fields showed a neutral test, but in places the soil was still slightly acid, probably owing to the fact that not enough lime had been applied. If the productivity of the soil is to be kept up, the growing of clover and other legumes is a matter of great importance; and if the liming of soils is the proper remedy for that condition which now renders the crop in some areas uncertain, it is certainly a practice that should be followed more generally by the farmers in the Wooster area.

AGRICULTURAL CONDITIONS.

The prospering state of agriculture in the Wooster area is shown by the generally thrifty appearance of the farms. The farm buildings as a rule are large and well kept. Frequently the houses are equipped with as many modern conveniences as city homes, having their own waterworks, sewerage systems, etc. The great number of large well-formed draft horses and the abundance of improved farm machinery also attest a flourishing agricultural community, while the generally high price of farm lands and the small number of mortgaged farms are further evidence of the prevailing prosperity.

About 60 per cent of the farms of the area are operated by the owners, the remainder being farmed by tenants on a share or cash basis. The farmers who do not operate their own farms have moved into the nearby villages and towns.

The size of the farms varies from 30 to 200 acres, but the average is about 90 acres. The price of land varies with the type of soil, improvements, and nearness to town. Very little land can be purchased for less than \$45 an acre, and some areas are held as high as \$200. The Volusia silt loam near Wooster can not be purchased for \$100 an acre. The Miami clay loam wherever found is valued from \$10 to \$15 an acre less than the Volusia silt loam adjoining.

Some labor is hired by the year, the wages ranging from \$18 to \$25 a month. During the harvesting season of some of the crops considerable help is hired, the usual wage being \$2 a day. As a rule, however, the small size of the farms and the employment of modern farm machinery make it possible for the farmer and his family to do the work. In the vicinity of the coal fields the labor conditions have interfered more or less with farming. Some of the farmers work in the mines and neglect their farms, while others do little with their land, the royalty from the underlying coal being sufficient to maintain them comfortably without work.

Wheat, corn, oats, potatoes, timothy and clover, orchard fruits, vegetables, berries, maple sirup, and tobacco are the important prod-

ucts of the Wooster area. A number of carloads of draft horses are shipped annually to the eastern markets, but these are nearly all shipped into the area from Indiana and Illinois when two or three years old and let out by the local horse men to the farmers to be fed until they are 5 years old, at which age they are in demand in the eastern markets. A few cattle also are bought and fed. The practice of feeding all the hay and straw of the farm and husbanding the barnyard manure has had much to do with maintaining the general productiveness of the soils of the area.

The transportation facilities of the area are very good. The Toledo division of the Wheeling and Lake Erie Railroad extends westward from Massillon to Orrville and then northwest to Creston. The Pittsburg, Fort Wayne and Chicago, with its excellent double-track service, passes through Massillon, Orrville, and Wooster and gives ready communication with the East and the West. The Cleveland, Akron and Columbus gives good service with Cleveland and the southern part of the State. The Cleveland, Loraine and Wheeling connects Massillon, Doylestown, and Sterling. The Baltimore and Ohio passes through Creston and Clinton and then north to Barberton, and the Millersburg branch of the Baltimore and Ohio comes down the Killbuck Valley and touches Wooster. The Erie enters the northern part of the area and connects Burbank, Creston, and Rittman. Besides these railway lines there is a trolley line, with cars running every hour, which connects Wooster with Cleveland, and another line connects Massillon and Canton. The Ohio Canal, which extends across the State from Cleveland to Portsmouth, crosses the eastern part of the area.

In addition to the railways there are good roads laid out on section lines, and some on half-section lines, and these place the farmers within easy reach of the railroads and towns. Substantial, well-built bridges, maintained at the expense of the towns and counties, are usually found across the creeks and rivers.

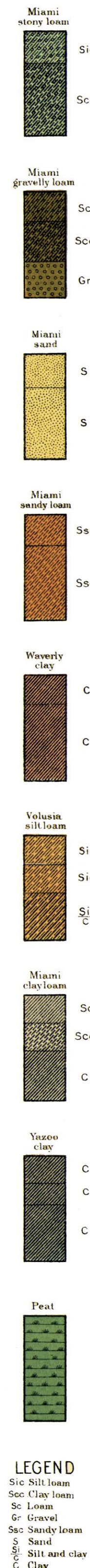
The products of the farm are readily disposed of in the nearby railroad towns, where there is usually active competition among local buyers.

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SOIL
PROFILE
(3 feet deep)



LEGEND

